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Editorial Announcement:

DISEASES OF THE CHEST invites contributions on any phase of diseases of the chest and related subjects of interest to the medical profession. These contributions should be neither too elementary nor too technical.

The purpose of DISEASES OF THE CHEST is to disseminate knowledge which will better equip its readers to diagnose and manage, as its name implies, diseases of the chest and related subjects dealing with public health.

The Associate Editors Board is now complete. It is hoped they will contribute articles and editorials, and we anticipate that they will be increasingly useful to the Editorial Board.

DISEASES OF THE CHEST has already demonstrated its usefulness and we hope it will become bigger and better. We want to encourage our younger Fellows and new members to prepare contributions. Actually, the writing of a paper will be their gain, because, in the preparation of a manuscript, they will be obliged to refer to literature with which they might otherwise not have been familiar. Thus, they will profit as much as, if not more than, the readers.

R. C. M.

The New Editor-In-Chief

RALPH C. MATSON, M.D.
Portland, Oregon

The name and achievements of Dr. Ralph Matson are, we know, familiar to most of our readers. To them, the name "Ralph Matson" symbolizes many advances of therapy in chest surgery. For those of our readers who do not know his qualifications for editing this journal, we present the following data:

Post-graduate Training

St. Mary's Hospital, London, and Cambridge University, Cambridge, England—1906-07.

University of Vienna—Apr. 1911 to Jan. 1912.

University of Berlin—Feb. 1912 to May 1912.

Academy of Medicine, Dusseldorf, Germany—May 1912 to Aug. 1912.

Victoria Park Hospital, Brompton and St. Mary's Hospital, London—1923.

Laennec Hospital, Paris—1923.

University of Vienna—Aug. 1, 1924 to August 1, 1925.

Brauer Clinic, Hamburg, Germany—August, 1925.

Hospital Affiliations

Associate Clinical Professor of Surgery (Thoracic Surgery), Univ. of Oregon Medical School, 1935.

Associate Clinical Professor of Medicine, Univ. of Oregon Med. School.

Director, Dept. of Surgery, Portland Open Air Sanatorium, Milwaukie, Oregon.

Chief Surgeon, University State Tuberculosis Hospital, Portland, Oregon, 1939.

Attending Specialist (Chest Surgery) Chest Surgical Center, Veterans Administration Hospital, Portland, Oregon.

Consulting Thoracic Surgeon, Doernbecher Memorial Hospital for Children, October 1934.

Chest Consultant, Multnomah County Hospital, Portland, Oregon.

Member of Visiting Staff, Good Samaritan Hospital, Portland, Oregon.

Co-Director, Tuberculosis Clinic, Medical Dept., University of Oregon.

Honorary Member of Staff, Lymanhurst School for Tuberculous Children, Minneapolis, Minn.

Member, Executive Faculty, University of Oregon Medical School, October 1940.

Member, Associate Medical Advisory Board, National Jewish Hospital, Denver, Colo., June 1941.

Societies, Associations, etc.

Past-President—American College of Chest Physicians, 1939.

Fellow—American College of Surgeons.
American College of Physicians.
American Medical Association.
Portland Academy of Medicine.
Senior Regent for Oregon and Specialty Regent in Thoracic Surgery, (National Regent, Feb. 1941)—Le College International De Chirurgiens, Geneva, 1937.

Titular Member—Union Internationale contre la Tuberculose (was American delegate to Lausanne meeting, Switzerland, 1923; Washington meeting, 1908; Rome meeting, 1912).

Senior Member—American Association for Thoracic Surgery.

Life Member—American Medical Association, Vienna.

Honorary Member—Minneapolis Surgical Society.
Kansas City Southwest Clinical Society.
Eastern Oregon District Medical Society.
Hollywood Academy of Medicine, Los Angeles, Calif.,
Sociedad Mexicano de Estudios Sobre Tuberculosis, Mexico, D. F.

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Closed Intrapleural Pneumonolysis

A two-year experience with Negroes

REUBEN HOFFMAN, M.D., F.A.C.C.P. *and* OTTO BRANTIGAN, M.D., F.A.C.S.
Henryton, Maryland

We wish, in this article, to discuss general principles associated with the operation of closed intrapleural pneumonolysis. Our observations are based on a two-year experience with the procedure employed on 109 patients, representing a total of 132 thoracoscopic examinations, with or without severance of the adhesions. All of the work was done on Negroes and, with the exception of one patient, all were performed at the Maryland Tuberculosis Sanatorium (Colored Branch), Henryton, Maryland.

Artificial pneumothorax, as a collapse measure, is widely employed. It is almost proverbial that where pneumothorax is induced, adhesions will be encountered. Adhesions between the parietal and visceral pleurae may vary from a single cord adhesion to a widespread symphysis of the two pleurae that completely obliterate the pleural space. In between these two extremes are encountered adhesions whose number, size, location, and appearance are truly protean. The adhesions, naturally, assume paramount importance since, in a large majority of the cases, they interfere with a satisfactory collapse. Figures showing the percentage of pneumothorax cases in which adhesions offer a barrier to an effectual collapse are given by Alexander[1] as 42-50 per cent. Jones[2] states "that only 50 per cent become effective, and that a successful end result was obtained in less than 50 per cent." Our experience shows a much higher percentage than the figures just quoted. A review of the records of 100 consecutive cases in which pneumothorax was induced shows that in 26 per cent there was either complete obliteration of the pleural space, or adhesions so widespread that only extremely insignificant collapse was obtained, and that in 62 per cent adhesions prevented a satisfactory collapse.

This brings clearly to the fore the fact that pneumothorax, unless supplemented by some other collapse procedure, is an inadequate therapeutic measure in the treatment of pulmonary tuberculosis. To us it has become inconceivable that a pneumothorax program can operate, with any appreciable degree of success, without facilities for performing, at the optimum time, some additional collapse measure.

The extra hazards that follow the maintenance of a pneumothorax, rendered ineffective due to adhesions, are an increase in the amount of spontaneous pneumothorax[3], an increase in the incidence of tuberculous empyema, and a greater frequency in contralateral or homolateral infection due to bronchogenic spread from uncollapsed cavities. In addition, a fair number of patients complain of pain due to the tug of adhesions on the parietal pleura. If the pain is not considered an important enough indication for relieving the pull of the adhesion, the potential danger of spontaneous rupture is.

The purpose of inducing a pneumothorax is the closure of cavities and when, due to adhesions, the closure does not occur within a reasonable period of time, some supplementary procedure must be employed. In the vast majority of cases a closed pneumonolysis is the procedure of choice.

There are other supplementary collapse measures that can be employed, the most frequently used being surgery of the phrenic nerve. Some prefer to do the phrenic first, which if unsuccessful, is followed by a closed pneumonolysis. We never consider other supplementary surgery until it has been proven that the adhesion cannot be severed. Our insistence upon performing a closed pneumonolysis as a primary supplementary measure is due to the fact that we consider a closed pneumonolysis less of a hazard and less liable to produce complications than the maintenance of a poor pneumothorax beyond a reasonable time. Surgery of the phrenic nerve rarely causes sufficient rise of the diaphragm or relaxation of the lung in these cases to effect cavity closure; and this is all the more true when the adhesions are horizontal. Too much time is consumed in determining whether this measure will work. The possibility of a complication arising during this interval that might cause the abandon-

ment of the pneumothorax and necessitating the substitution of a more serious procedure is too great to justify the routine use of a phrenic crush.

Once a collapse measure has been instituted, the cavity closure (or control of disease) should be brought about as rapidly as is consistent with safety.

We do not adhere to the policy of lengthening the interval between the induction of the pneumothorax and the performance of the closed pneumonolysis on the expectation that by the judicial (or otherwise) use of positive pressures the adhesions can be stretched sufficiently to close the cavity. We definitely oppose high pressures on the ground that they cause an increase in the number of spontaneous pneumothoraces due to the rupture of the lung at the visceral attachment of the adhesion or to the rupture of the adhesion itself. More important, however, is the knowledge that the great majority of adhesions encountered are too thick and too ramifying to expect them to stretch to a degree sufficient to bring about cavity closure. One careful examination of the average unsuccessful pneumothorax (due to adhesions) through a thoracoscope will be convincing proof of the utter futility of expecting most adhesions to stretch. As an actual matter of fact we strongly suspect that the reverse procedure (contraction of the adhesion) is more likely to ensue as the pneumothorax is maintained. Adhesions are the end result of a tuberculous lesion in the two apposing pleurae and, as healing progresses, fibrous tissue is formed which ultimately hyalinizes. The latter characteristically undergoes contraction. That adhesions grow shorter in some pneumothoraces is not an infrequent occurrence and, as such, can bring about the complete loss of the pneumothorax space. Once the contraction begins, progressive obliteration may be quite rapid.

It is generally agreed that the greatest number of successful pneumothoraces become so within three months and that to maintain a partially successful pneumothorax beyond that point is to invite complications and a final bad result. With this we are in accord, but we favor shortening the time interval between induction of the pneumothorax and the closed pneumonolysis. There is no time interval that is considered best, since it is our opinion that the interval of time between the induction of the pneumothorax and the closed pneumonolysis is the least important of all the factors. We favor early attempts to sever the adhesions since it is our experience that "early" adhesions are easier to sever and that bleeding is less likely to occur. As soon as a pneumothorax is considered ineffectual because of adhesions and, in the great majority of cases, this is obvious long before three months, a thoracoscopic examination should be done and adhesions severed if safely operable. The criteria for a thoracoscopic examination, therefore, are that there are adhesions interfering with a satisfactory collapse, that the pneumothorax is stabilized, and that there is sufficient space for the safe manipulation of the instruments.

The knowledge as to whether an adhesion can be severed can be ascertained by several methods. Fluoroscopic examination, and flat, lateral, oblique and stereoscopic films are offered as accessory methods of examination. We have found such methods unsatisfactory. It is a notorious fact that an x-ray very commonly gives an erroneous impression of what the conditions are in the pleural cavity. Adhesions are commonly seen through the thoracoscope that do not appear on the film; thin cord adhesions not infrequently turn out to be the edge of a ramifying sheet of adhesions that sweeps across the pleural cavity; "hopeless" adhesions not infrequently turn out to be simple as far as severing them is concerned. The x-ray can be of only one definite value and that is to give the operator a general idea of what he can expect to encounter and to allow him to choose that site which is most likely to give him best access to the adhesions. There is only one efficient method of determining the operability or non-operability of adhesions: a careful examination through a thoracoscope.

Occasionally the question arises whether an adhesion should be severed even though a good collapse has been obtained and the sputum has become negative. There are two chief instances where the necessity for making this decision arises: one, where the "pulmonary insertion" of the adhesion is adjacent to a peripheral focus of disease; two, where an effectual collapse of the diseased part of the lung can be brought about only

by additional collapse of the uninvolved part of the lung.

Unhealed foci of disease are found in those parts of the lung to which adhesions are attached, due to the constant pull of the adhesion. This pull is intensified if moderate positive pressures, which in this type of case is not infrequent, have to be employed. These factors lead to a focus of disease that is kept activated by movement (the opposite reason for which the pneumothorax was instituted) and the resulting increased hazard of a spontaneous pneumothorax due to rupture of the lung at this point. In this type of case we advocate a closed pneumonolysis.

The ideal type of pneumothorax is selective: where the diseased portion of the lung remains collapsed and the uninvolved portion only partially (or not at all) collapsed. It has been noted that adhesions prevent selective collapse and that uninvolved lung is needlessly sacrificed. Since the goal we strive for is a selective collapse, we advocate a closed pneumonolysis in this type of case.

Since bilateral pneumothorax is a procedure used, it goes without saying that the necessity for performing a bilateral pneumonolysis will arise. The indications for performing a closed bilateral pneumonolysis are no different than when dealing with unilateral collapse. One obvious precaution should be taken: to be sure that the patient's vital capacity is great enough to withstand this procedure. A near fatal case was encountered in our series when this precaution was overlooked.

Much has been written about the respective merits of galvano-cautery and electrocautery. We can add nothing to such a discussion. Obviously, the operator will use that instrument and that technic which experience has taught him produces the best result. One of us (O. C. B.) has had ample experience with both types of cauteries and now uses exclusively the galvano-cautery. All the work done at the sanatorium, with the exception of one case, was with the two-puncture galvano-cautery.*

The first puncture site is chosen according to the location of the adhesions as visualized on the x-ray. The most commonly used site is the mid-clavicular line in the first interspace. If, after a thorough examination (through a second puncture site if necessary), the adhesions are considered operable, the closed pneumonolysis is performed. Occasionally, to complete a pneumonolysis, it will be necessary to insert a third canula. We have never seen any ill effects from the third puncture wound.

Frequently, we find it necessary to perform a closed pneumonolysis in several stages. In some instances, after all visible adhesions have been severed, subsequent x-rays show that the lung did not collapse as well as was expected or that in spite of an apparent good collapse the cavity remained partly open. As the pneumothorax is maintained there is a slowly increasing collapse which reveals the presence of additional adhesions which could not be seen at the first operation. Subsequent severance of these adhesions renders the pneumonolysis complete and a satisfactory collapse is obtained.

In other instances, the adhesions are seen to contain lung tissue so close to the chest wall that it is considered unsafe to attempt their severance. Providing there are no adjacent vital structures that can be damaged, these adhesions can be approached in two ways. After incising the parietal pleura with the cautery, the parietal attachment of the adhesion is enucleated with the cold blade until it hangs by a strip of parietal pleura. The latter is then severed with the heated cautery and the division of the adhesion is completed. The other method is to incise the parietal pleura around the adhesion (about 1½ - 2 cms. away from the adhesion) and after 6 to 8 weeks perform a second operation. At this time it is usually observed that the adhesion has stretched to a sufficient degree to allow its complete severance.

On occasions, adhesions will be encountered that are so numerous and ramifying that it is not feasible to attempt their severance at one sitting. So much time would be consumed that the possibility of fistulization of the chest wall from the heat and pressure of the instruments has to be considered. Although we have no rule, we rarely prolong any one operation over 60 minutes.

Frequent fluoroscopic examinations for the first week, with appropriate amounts of air, are necessary for the maintenance of the pneumothorax after the closed pneumon-

* Coryllos thoracoscope, American Cystoscope Makers, Inc.

olysis. Special care must be exercised in the face of a rapid loss of air, as evidenced by marked subcutaneous emphysema, since the pneumothorax space can be lost through excessive leakage of air through the operative puncture wounds.

Fluid is a routine complication following pneumonolysis and is ignored unless it accumulates in sufficient degree to cause respiratory embarrassment or if infection is suspected. Spontaneous absorption is the rule.

Complications of the closed pneumonolysis aside from subcutaneous emphysema and fluid formation are bleeding and empyema. Bleeding, though feared, has only occurred once in our series. In this case the bleeding occurred from the parietal stump of the adhesion and the judicious application of heat and pressure were necessary for a half hour before it was controlled. The patient lost an estimated 100 cc. of blood, but no ill effects were noted. The blood was allowed to absorb spontaneously.

Mixed infection empyema occurred twice. In one instance (proved by autopsy) it was due to a spontaneous pneumothorax. In the other instance it was due to an apparent spontaneous pneumothorax. After a stormy course, this patient has finally improved to the point where she is now posted for a thoracoplasty. In a third case, a pyogenic empyema was encountered in which only staphylococci were found by bacteriological examination. This case came to a fatal end. Tuberculous empyema following closed pneumonolysis has been seen in about 5 per cent of the cases. The definition of the tuberculous empyema in this case is limited to purulent or semi-purulent fluid appearing within thirty days following the operative prodecure, which contains tubercle bacilli, but no pyogens. We are not altogether convinced that the occurrence of this type of empyema might not have come about even if the closed pneumonolysis had not been done. Pending further studies, we are classifying it as an operative complication. In nearly all cases this type of empyema has been successfully controlled with irrigation and antiseptics; one had to be converted to oleothorax.

Conclusions

1) When adhesions are preventing a satisfactory collapse, the operation of closed intrapleural pneumonolysis is the procedure of choice.

2) Time is not a factor in deciding when the pneumonolysis should be done; sufficient space for the safe manipulation of the instruments is the important criterion.

3) There is only one accurate method for determining the operability of adhesions: careful examination through the thoracoscope.

4) A closed pneumonolysis is less hazardous than maintaining an ineffectual pneumothorax beyond a reasonable time, or the substitution of a phrenic crush that carries a poor chance of succeeding.

5) Principles and indications for bilateral pneumonolysis are the same as those for unilateral pneumonolysis.

References

1 Alexander, J.: *The Collapse Therapy of Pulmonary Tuberculosis*, 1937.
2 Jones, H. A.: *American Review of Tuberculosis*, Vol. XL, pg. 722.
3 Matson, Ralph C.: *American Review of Tuberculosis*, Vol. XXXIX, pg. 162.

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Chemotherapy in Management of Pneumococcic Pneumonia*

ABEL LEVITT, M.D., F.A.C.P., HAROLD T. SCHWEITZER, M.D. *and* KENNETH GOLDSTEIN, M.D.
Buffalo, New York

Since the advent of specific chemotherapy in the management of pneumonia, the mortality rate has tremendously declined, and pneumonia is no longer feared in any of the age groups. If properly and adequately treated, the disease runs a rather benign course, and in the absence of complications or concomitant systemic disease it has lost its serious aspects.

The early diagnosis and immediate institution of therapy are absolutely essential. The diagnosis should be based upon the more or less characteristic onset and symptomatology of the disease, rather than physical signs which are frequently late in making their appearance. Positive x-ray findings often become manifest at an earlier time than physical signs, but this procedure is not always available. In all instances in which pneumonia is at all suspected, it is advisable to obtain a complete blood count, typing and culture of sputum, and blood culture, as these are valuable aids in the diagnosis, therapy, and prognosis. These laboratory procedures, however, must be carried out before institution of treatment, as they may be altered by the effect of the therapeutic agent. However, in no case should treatment be delayed while waiting for the results of these tests.

Having made the diagnosis of pneumonia, one should decide early whether hospitalization is necessary, since it is dangerous to move a patient in the advanced stage of the disease. In the presence of adequate nursing care, proper isolation, and essential equipment (e.g. Oxygen, etc.), pneumonia can be treated equally as well at home as in the hospital.

The sick room should be well ventilated and, if possible, a constant temperature of about 65° F. should be maintained. Careful isolation and complete aseptic technique should be utilized by attendants. The sputum should be carefully collected in paper tissues or cups and destroyed. Visitors should not be allowed in the sick room.

Special nursing care is of utmost importance. The essential function of the nurse is to make sure that the patient secures the greatest amount of rest and sleep consistent with carrying out her orders. The patient should be propped up in bed on several pillows, dependent on individual comfort. Occasionally, the patient may be turned from his back to lie on the affected side, but frequent moving is inadvisable.

In order to obtain proper rest, sedatives are indicated. The opiate is the drug of choice. The average patient will require 1/6 to 1/4 gr. of morphine sulfate given hypodermically about every six hours. The barbiturates and allied sedatives have been found to be less effective, and tend to produce gastric distress. The physician should make it a rule to visit the patient more than once daily during the acute phase of the disease, but should avoid sitting the patient up during examination.

The diet should be of a liquid nature and of sufficient caloric content. Fruit juices, milk, and broth are the principal foods. A minimum of 3,000 cc. of fluids a day is recommended. Orange juice, while an excellent food, will, if taken in excess, result in gastric upset and may then be replaced by other fruit juices, milk, or charged waters. Should the patient be unable to consume the three liters of fluid per day orally, then 5 per cent glucose in saline should be given by hypodermoclysis in sufficient amount to make up the balance.

The bowels should move at least once every 48 hours. If the fruit juices in the diet do not accomplish this, an enema should be given every other day. A teaspoonful of salt to a pint of water is used. Cathartics are best omitted since they disturb the patient and are difficult to control.

We have used sulfapyridine administered orally in over 200 cases of pneumonia, irrespective of the pneumococcic type. Originally, we restricted its use to those patients who

* From the Medical Service of the Edward J. Meyer Memorial Hospital and the University of Buffalo School of Medicine.

had a definite leucocytosis. Later we disregarded this restriction and found that patients who had a leukopenia in the beginning soon developed a leucocytosis following the administration of the drug, without deleterious effect as the result of this. Two grams of sulfapyridine crushed and dissolved in milk were administered as a first dose and followed similarly by one gram every six hours throughout the day and night. This was continued until the patient's temperature remained normal for approximately seventy-two hours. In no case did we exceed a total of 39 grams. In the majority of cases much less was required. If the drug was discontinued too soon following the drop in temperature, a secondary rise of fever sometimes followed. The duration of illness following the administration of the drug varied. In some of the patients temperature dropped by crisis within twenty-four hours, but in the majority the temperature dropped by lysis within seventy-two hours.

In an analysis of 100 cases in which this drug was used there were twenty-five patients with type I pneumococcus, fourteen with type II, six with type III, three with type IV, three with type V, one with type VI, seven with type VII, and one with type XIV; thirteen gave a culture of streptococcus anhemolyticus and staphylococcus albus; three revealed gram positive cocci, soluble in bile; and the remainder were negative for type and culture. Of this group we had a mortality rate of 3 per cent. There were present in this series two cases of pregnancy in mid-term who recovered. The blood culture was positive in only four instances, all of whom recovered. They were types II, VI, XIV, and one streptococcus hemolyticus. The ages in this group varied between one and eighty years with a maximum number in middle life. With a dosage of the drug as stated above, we obtained a blood concentration which varied between 1 and 11.2 mg. per cent. Upon studying the record it is apparent that the blood concentration of the drug varies considerably in different individuals, despite the fact that the same oral dose was used for all patients. The optimum blood concentration was considered to be between 5 and 6 milligrams per cent.

Reactions in our series were not serious. Nausea and emesis occurred in 19 per cent of the group. Cyanosis was of rather frequent occurrence. Delirium was present in four patients. Three individuals developed serofibrinous pleurisy which eventually disappeared. In most of the cases the physical signs of resolution were somewhat prolonged after the temperature had become normal. In one instance a patient had two recurrences of pneumonia, each time in a different lobe, at intervals of several months and recovered.

Sodium Sulfapyridine Monohydrate

This soluble derivative of sulfapyridine was administered intravenously to a group of patients for the purpose of comparing its effect with that of the orally administered sulfapyridine. A 5 per cent solution of the drug, obtained by dissolving 4 grams of the powder in 80 cc. of distilled water, was employed. This amount was administered once daily, irrespective of the size of the patient or the type of pneumonia. No other medications were used. Blood sulfapyridine determinations were made at frequent intervals.

With a single intravenous dose of this drug, the blood sulfapyridine level shortly (10 minutes) following injection reached an average concentration of 9.3 milligrams per cent. At the end of one hour there was about a 20 per cent depreciation. This became 25 per cent at the end of 4 hours. At the eight hour period the decrease in blood sulfapyridine was 37.5 per cent of the original value. Twenty-four hours following injection an average level of 5 milligrams per cent was obtained. It appears that in order to maintain a level in the blood of 6 to 7 milligrams per cent, one should administer 80 to 100 cc. of a 5 per cent solution about every 18 hours. The blood concentration of sulfapyridine varies to a considerable extent in each case irrespective of the patient's age, sex or weight.

The blood concentration with the oral use of sulfapyridine was, as an average for the twenty-four hours, 3.93 milligrams per cent. With the intravenous use of sodium sulfapyridine monohydrate, the average level was 8 milligrams per cent in the blood for the twenty-four hours.

The duration of illness, with the intravenous use of the drug, varied. In 40 per cent of the patients the temperature dropped by lysis or crisis within forty-eight hours; in 30 per cent of the group within 4 days, and

in the remaining cases within a week.

The reactions with sodium sulfapyridine were similar to those which occurred with the orally administered sulfapyridine. Nausea and emesis were evident in an equally large number of cases. Cyanosis appeared to be about three times more frequent in this series; similarly, the complaint of headache was noted in more cases. In two patients definite icterus occurred. Two deaths occurred in this series, providing an 8 per cent mortality rate.

In our opinion the intravenous drug has no particular advantages over the orally used medication, and its use is indicated only in those cases where constant emesis prevents administration by the oral route or in those cases where loss of consciousness prevents swallowing.

Sulfathiazole

Sulfathiazole was administered to a group of fifty-five patients whose ages varied between ten and eighty years, the majority of whom were in middle life. Four grams of sulfathiazole, crushed and suspended, in milk were administered as the first dose; to be followed by one gram every four hours throughout the twenty-four hours. Treatment was continued for seventy-two hours following the drop in temperature. By this method of administration the blood sulfathiazole average throughout the course of the illness varied between 3 and 5 mg. per cent. The temperature dropped by lysis or crisis in forty-eight hours in 12 per cent of the cases, within five days in over 60 per cent of the group, and the remainder shortly thereafter. The average amount of drug used varied between twenty and forty grams. The mortality rate with the use of this drug was 18.1 per cent. This is considerably higher than with the sulfapyridine group and we believe this was due principally to the concomitant diseases and larger number of patients in the more advanced age groups. The reactions resembled those of sulfapyridine both in nature and frequency.

TABLE I

Reactions and Complications

REACTIONS	*Sulfapyridine Percentage of Cases*	*Sulfathiazole Percentage of Cases*	*Sodium Sulfapyridine Percentage of Cases*
Nausea	17	30.0	84
Emesis	22	21.8	84
Cyanosis	18	54.5	52
Headache	0	16.3	36
Delirium	4	1.8	16
Agranulocytosis		1.8	
Thrombocytopenic Purpura	1		
Jaundice			12

TABLE II

Sputum Typing

Sulfathiazole:

TYPE	*Number of Cases*	*Percent*	*Sera*	*Positive Culture*	*Mortality Percentage of Total*
I	5		4	1	1.8
II	1	1.80			
III	8	14.50	4	1	1.8
VII	2				
VIII	3	5.40	3	1	1.8
XII	1		1	1	1.8
XVIII	2				
XIX	2				
XXI	1				
XXV	1				
XXXI	2	3.60			
Staph. & Strep.	5	9.09	4		1.8
Negative	22	40.00		3	7.27

Sodium Sulfapyridine:

TYPE	*Number of Cases*	*Percent*	*Sera*	*Positive Culture*	*Mortality Percentage of Total*
I	1	4		1	
II	6	24		1	4
III	2	8			
IV	3	12		1	
VIII	2	8			
Undetermined	2	8			
Negative	9				4

Sulfapyridine:

TYPE	*Number of Cases*	*Percent*	*Sera*	*Positive Culture*	*Mortality Percentage of Total*
I	25	25			2%
II	14	14			
III	6	6			1%
IV	3	3			
V	3	3			
VI	1	1			
VII	7	7			
XIV	1	1			

Of the remainder, 24 cases were negative for typing and culture; 13 produced a culture of streptococcus anhemolyticus and staphylococcus albus; and 3 cases revealed gram positive, ox-bile soluble cocci.

TABLE III

Blood Concentration Levels in Milligrams Per Cent

Sulfathiazole Level Averages	*MG. %*
End of 24 hours	4.81
End of 48 hours	4.07
End of 72 hours	2.68
End of 96 hours	3.30
End of 120 hours	3.02
End of 144 hours	2.70
End of 168 hours	4.10
Sulfapyridine Oral Administration	*MG. %*
End of 24 hours	3.93
End of 48 hours	5.20
End of 96 hours	6.85
End of 120 hours	5.84
End of 144 hours	3.37
End of 168 hours	3.53
Sodium Sulfapyridine Intravenous Administration	*MG. %*
End of 24 hours	5.60
End of 48 hours	6.04
End of 72 hours	6.00
End of 96 hours	8.60

Antipneumococcus Serum

With the use of the specific drugs, serum was used only when the patient was critically ill or did not soon respond to the drug therapy. With the oral sulfapyridine group we used horse serum in twenty cases of type I pneumococcus. With sodium sulfapyridine intravenously, we did not use any serum. In the sulfathiazole series we used antipneumococcus rabbit serum in eight of the cases and horse serum in four type I cases. No other drugs were used except for symptomatic relief.

Symptomatic Treatment

Cough was relieved by the use of codeine sulfate ¼ to ½ grains administered orally or hypodermically as often as indicated. Whiskey was used only in alcoholic patients, ½ ounce four times daily. For temperature above 103°, a tepid sponge was helpful. Pain in the chest, if distressing, may be relieved by counterirritants such as mustard plaster, poultices or fixation by adhesive plaster.

In those cases where cyanosis was found to be due to the drug used, (sulfapyridine, sulfathiazole, etc.), oxygen appeared to have little or no effect.

Digitalis has no influence on the course of pneumonia and should be used only in the presence of cardiac failure complicating the disease. Intestinal ileus, noted occasionally with the use of the specific drugs, may be treated by rectal tube, turpentine stupes or enemas. If no relief is obtained with these measures, ½ to 1 cc. of pituitrin subcutaneously or prostigmine grains ¼ may be used. As a final measure, duodenal decompression may be indicated.

Singultus, either due to acidosis or diaphragmatic irritations, occurs with moderate frequency and may be treated either with 50 cc. of 50 per cent glucose intravenously, morphine and atropine, compound spirits of ether or sweet spirits of niter. Inhalation of 5 per cent carbon dioxide in oxygen is effective in many instances. As a last resort phrenic crush may be necessary.

Conclusions

1) Sulfapyridine has given us excellent results and the lowest mortality rate in the treatment of pneumonia. Complications were rare, and reactions few.

2) Sodium sulfapyridine monohydrate produces results similar to those of the oral drug. It has no advantages over it except in those patients who for various reasons are unable to take the drug orally; and should be used only in those instances. Occasionally, in an emergency it may be advisable to begin treatment with one injection of sodium sulfapyridine, and then continue with sulfapyridine orally.

3) Sulfathiazole in our cases has not been as efficient as sulfapyridine. Reactions to this drug closely resemble those of the others, and clinical response is slightly slower.

4) In the more severe cases of pneumonia, it is advisable to use both serum and drug therapy. Also, when the patient does not appear to respond satisfactorily to drug therapy, serum should be given without further delay.

5) Early chemotherapy is of paramount importance, and appears to bear a direct relationship to the length of convalescence. Much valuable time is lost in waiting for classical physical signs to appear.

Carcinoma of Lung

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The tremendous interest in carcinoma of the lung is due to a number of reasons, among which are: (1) The increasing incidence, (2) The relative frequency, (3) The evolution and perfection of thoracic surgery.

1) The increasing incidence, whether real or apparent, is still controversial, but seems to be real.

2) The lung now is said to be second in frequency only to the stomach as the primary site of cancer.

3) The rapid strides in the technical development of thoracic surgery have been startling, and in a scant seven years the prognosis of lung carcinoma has been changed from an absolutely hopeless to a relatively favorable one. In this short time, the mortality has decreased in 151 reported cases from 100 per cent to 45 per cent.

The most important remaining obstacle to surgical therapy in carcinoma of the lung is the lack of an early diagnosis.

Some of the reasons for this are:

1) The absence of a definite pattern of early typical signs and symptoms.

2) The fairly recent acquisition of our knowledge, relative to this condition.

3) The failure to use the known diagnostic procedures such as x-ray, bronchoscopy, bronchography, bronchial catheterization, thoracoscopy, aspiration biopsy, kymography, tomography, and arteriography. Early diagnosis is most important if the percentage of operability is to increase. During the past 2½ years, 23 cases of lung carcinoma were observed. Of this number 14 (60%) were considered inoperable because of the extension of the process, and 9 (40%) were considered operable. Of the 9 patients operated upon, in only 4 (44%) was the disease limited, so that pneumonectomy could be performed. Thus, the actual operability was 4 of 23 cases (17%). Two of these pneumonectomies are living (50%) and two died as a result of the operation.

Many times it is impossible to secure a positive microscopic diagnosis before the operation and the insistance upon positive histologic proof before operation has led to the death of some patients who might have been subjected to operation with at least an even chance of recovery. For those who continue to demand histologic proof before operation, the following facts may be reviewed.

The incidence of benign tumors of the lung is low and much lower than that of primary malignancy. While a tumor may be benign from the histological slide, it may also be malignant from the functional viewpoint, in that it may be the direct cause of complications which lead to the death of the patient.

Churchill reports a series of 380 cases of primary tumor of the lung. Of this group, the frequency of benign tumors, as calculated by microscopic confirmation was 10 per cent. Of this group in which resection was carried out, the benign lesions accounted for 30 per cent of the resectable tumors. The mortality of the benign tumors was 36 per cent.

The role of aspiration biopsy is still uncertain, but it appears to be of value in a limited number of cases. The routine use of aspiration biopsy to add a final histological proof to an established diagnosis, can only bring discredit to a procedure that has some definite value. Craver recently reported a series of 230 lung aspirations, 64 of which resulted in histological proof of carcinoma. In this series, the only complications were two instances of air embolism. During the past two years I have had empyema develop in two instances following lung aspiration.

We are constantly attempting to determine the place of irradiation therapy in primary carcinoma of the lung. At the present time, the concensus of opinion seems to limit this therapy to the palliative treatment of the inoperable cases.

The pre-operative preparation should include all measures that may add to the patient's ability to withstand the operation—the most important of these are: blood transfusions, high vitamin and high caloric diet supplemented by the administration of large doses of vitamins B and C, pneumothorax whenever possible, postural drainage, and repeated bronchoscopic aspiration where secretion is present. We have not found it neces-

sary to use the intrapleural injection of beef broth as suggested by Rienhoff.

Anesthesia in lung surgery is a vital problem, and it is here that a competent, experienced anesthetist may mean the difference between success and failure to the surgeon. The most important features of the anesthesia are the maintenance of a differential pressure, high oxygenation and frequent aspiration of the tracheo-bronchial tree.

Reid and Brace have shown that vagal stimulation occurs during the passage of the endotracheal tube and upon the inflation of the occlusion cuff on the tube. This reflex vagal stimulation is manifested as changes observed in the EKgs. and may have a deleterious effect upon the heart. We believe that this reflex stimulation has been directly responsible for one death. These same authors also show that the reflex vagal stimulation can be largely eliminated by giving adequate doses of atropine before the operation.

The incision and operative technique are determined somewhat by the site of the tumor and the presence or absence of adhesions. The anterior approach appears to be indicated for upper lobe involvement and the posterior approach for lower lobe involvement.

It is desirable to inject novocaine around the hilar structures and especially the bronchus before manipulating these structures, since severe cardiac and respiratory disturbances have been frequently observed. This occurred twice in our series and in one instance could not possibly have been due to traction on the pulmonary artery as that structure had already been ligated and divided.

Individual ligation of the hilar structures is desirable in every instance. After the lung is removed, the mediastinal glands are removed. Careful pleuralization of the mediastinum decreases the danger of infection and aids in the healing of the bronchial stump.

The incision is closed in layers and no drainage is instituted as it is important to have the pleural cavity filled with a fibrinous exudate.

Recent experimental evidence tends to show that the fate of the remaining lung depends somewhat upon the age of the patient. Longacre and Johansmann showed that in puppies, following pneumonectomy, a true hyperplasia and regeneration of the respiratory units occurred in the remaining lung with no loss of pulmonary function. In adult dogs, however, a compensatory dilatation of the lung occurs which is later followed by a true chronic interstitial emphysema with a definite decrease in pulmonary function. In view of these results, it may be advisable in some adults to perform a thoracoplasty to prevent the development of emphysema.

The post-operative care consists principally in supportive measures such as continuous oxygen inhalation and blood transfusions, especially since a large amount of serum will escape into the pleural cavity. The foot of the bed is elevated to promote tracheo-bronchial drainage. Deep respirations and coughing are encouraged at least once each hour.

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Intrapleural Hemorrhage

Its Occurrence in the Course of Artificial Pneumothorax Treatment for Tuberculosis

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Introduction

Massive hemorrhage into the pleural cavity may result from a number of causes: (1) Trauma in military and civil life; (2) Spontaneous rupture of the lung with ensuing intrapleural hemorrhage, occurring in previously healthy people, the so-called idiopathic variety; (3) Evolution of an active tuberculosis in which spontaneous pneumothorax precedes the hemorrhage; and (4) As a complication in the course of therapeutic pneumothorax for tuberculosis. Whatever the causative mechanism may be in a given case, observers are unanimously of the opinion that hemorrhage into the pleural cavity is invariably preceded by a concomitant spontaneous pneumothorax. The presence of blood and air in the pleural cavity is designated as hemopneumothorax.

The purpose of the present communication is to discuss intrapleural hemorrhage as a complication of artificial pneumothorax, and to report a clinical case. It is noteworthy that very few cases have been reported altogether, and especially so in the English language. The cases reported in this language have been observed in America.

The first case was reported by Heise and Krause[1] in 1920. The patient had massive intrapleural hemorrhage which occurred several hours after a pneumothorax refill. Postmortem examination revealed an apical cavity which had ruptured into the pleural sac.

Two cases were reported by Korol[2] in 1936. He advanced the theory that hemorrhage occurs as the result of a concomitant spontaneous pneumothorax; that the weight of the collapsed lung exerts a sudden pull upon pleural adhesions, producing a sudden and violent tearing of a blood vessel or vessels.

Three additional cases were reported by Hurst and Epstein[3] in 1937. They called this condition hemopneumothorax, and advanced the hypothesis that hemorrhage occurs either as the result of a rupture of an emphysematous bleb or a tuberculous focus; that the extent of hemorrhage varies with the size of the vessels involved. They do not consider the rupture of adhesions as a likely cause of bleeding, citing the rarity of intrapleural hemorrhage in cases of spontaneous pneumothorax which have complicated cases of induced pneumothorax known to have adhesions.

Case Report

E. A., female, age 23, first came under observation in August, 1934. Patient had a caseating, cavernous, lesion involving the left upper lobe, for which the writer instituted artificial pneumothorax. Marked clinical recovery was achieved, but the cavity remained open because of pleural adhesions. A successful pneumolysis was performed in May of 1935. The cavity remained closed thereafter. Patient continued to remain well; was married a month later, and was delivered of a normal baby in February, 1936. Patient received pneumothorax during and following delivery. No untoward reactions had occurred during the entire period of treatment until the complication to be described. This followed the last refill which was given on October 16, 1936. Patient was seen at her home by the writer five days afterwards. The following story was obtained:

Patient felt uncomfortable upon reaching home following the refill. There developed in succession, left-sided chest pain, dyspnea and nausea. Examination of the patient revealed moderate dyspnea and pallor. Temperature was 101.5° F., pulse 110, respiration 28. Chest examination elicited flatness over the lower thorax with hyper-resonance over its upper part. Cardiac dullness and apex impulse were shifted to the right side. The findings were consistent with a hydropneumothorax. Intrapleural hemorrhage was not suspected. However, realizing that a complication of some magnitude had taken place, tapping of the chest was suggested. This was

not accomplished, as both patient and husband declined to cooperate. Sedation was prescribed and radiography of the chest was advised; and patient was to be seen the following day. The writer lost sight of the patient from that time on. She was subsequently admitted to a local sanatorium. The following report, dated 3/24/37, was sent to me by the sanatorium director:

"E. A. was admitted to the hospital on October 29, 1936, complaining of increasing shortness of breath for the previous two weeks, marked pain at the site of the pneumothorax refill; temperature 104°, pulse 150, respiration 36. Thoracentesis done soon after admission revealed positive pressure of 20 cm. of water; 300 cc. of dark blood was aspirated, 750 cc. air was removed and pressure of −16 to −5 cm. of water was left within the chest. Her pulse returned to 120 and respiration 18. Two days later 300 cc. of dark blood was aspirated again and her condition improved. At this time, hemoglobin dropped to 45 per cent and R.B.C. 2,200,000. Iron-liver therapy was begun and by the first of January, 1937, R.B.C. was 4,000,000 and HgC 72 per cent. At the present time (3/23/37) R.B.C. is 4,320,000, HgC 84 per cent. Vital capacity, not determined on admission, is now 2750 cc. Sputum always negative; blood sedimentation curve had gone from 37 mm. to 25 mm. The patient has made excellent progress, having gained in weight and strength. Diagnosis: Hemopneumothorax."

Treatment

In a detailed study of the subject, Hurst and Epstein[3] have stressed two principles underlying the successful management of intrapleural hemorrhage: (1) Relief of dyspnea, and (2) Replacing blood loss. They treat the former by aspirations and the latter by transfusions. One of their cases was treated by the latter method. Generally, these writers are inclined to resort to transfusion when the simpler method of chest tapping and air withdrawal fails to improve the patient's condition. Under these circumstances it is assumed that active hemorrhage has not ceased. These observers agree with Bernard[4] who advocates "gentleness under all circumstances." The latter advises no treatment at all if the patient is comfortable. If, however, dyspnea increases, he favors small frequent aspirations. With regard to treatment, it is obvious that unanimity exists on the advisability of avoiding trauma to the pleura since these patients are already in a state of shock. Hence, even simple needling of the chest may be too much for them.

Discussion

With regard to the complication discussed in this communication, it should be emphasized that when severe symptoms arise during or after a pneumothorax refill, the following complications may be suspected: (1) Pleurisy with effusion, (2) Spontaneous pneumothorax, and (3) Empyema. One does not ordinarily think that intrapleural hemorrhage may occur. The true diagnosis can be established only when free blood is found upon tapping the chest. The findings in a case of hemopneumothorax are very high intrapleural pressure and aspiration of blood. The latter will be bright in color if hemorrhage is of recent origin, and dark in color if the hemorrhage is old.

In general, treatment consists of the removal of blood and air at indicated intervals to combat dyspnea, and/or transfusions in those cases in which bleeding is continuous, or to replace excessive blood loss.

Summary

1) Massive intrapleural hemorrhage may arise as a complication of artificial pneumothorax treatment for tuberculosis.

2) The diagnostic and therapeutic features of this complication have been outlined.

3) This report is an addition to the meager number of cases recorded in the literature.

I am indebted to Dr. Nahum Pillsbury, Medical Director, and to the staff, of the Norfolk County Sanatorium, Braintree, Mass., whose courtesy afforded me the opportunity to record the later phases in the clinical evolution of the case reported.

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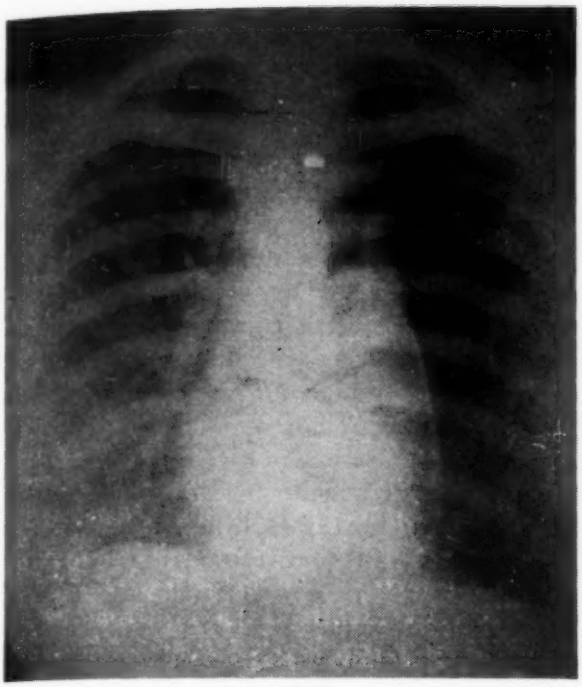

FIGURE 1

9/36—Successful artificial pneumothorax before complication set in.

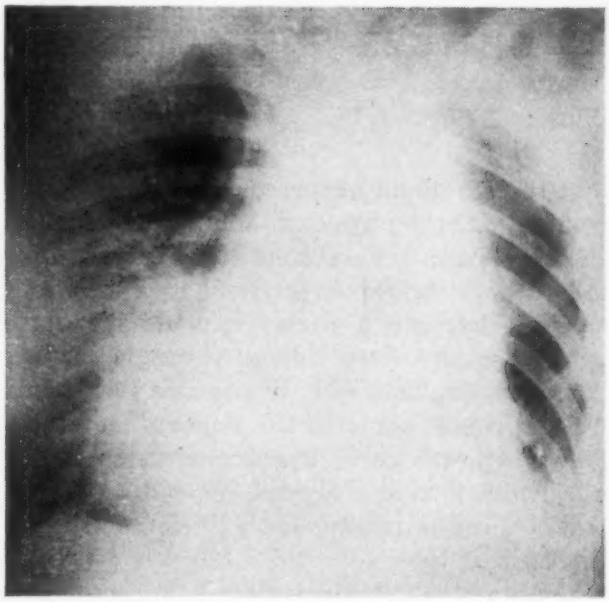

FIGURE 3

11/2/36—Three days later, after second aspiration of blood. Note complete pneumothorax with small amount of residual fluid.

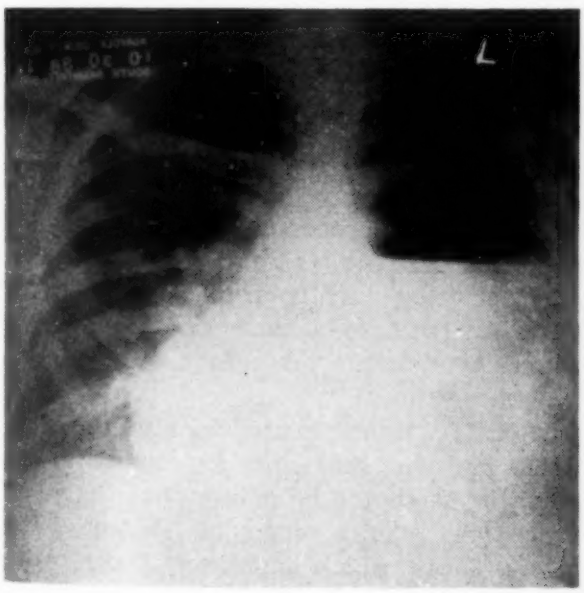

FIGURE 2

10/30/36—The left chest cavity presents a hydropneumothorax. Note complete lung collapse with cardiac displacement to the opposite hemithorax, two weeks after preceding refill, and before aspiration of blood and air.

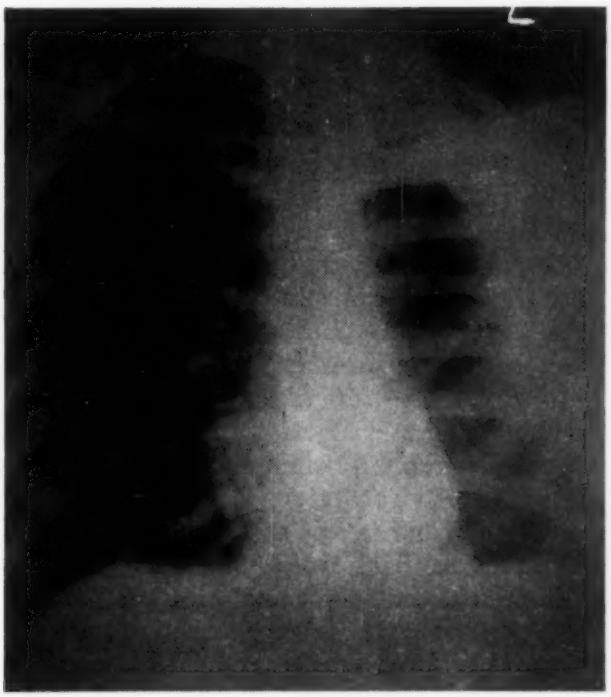

FIGURE 4

3/22/37—Note nearly complete expansion of involved lung. The upper and outer hemithorax presents a shadow of density probably due to encapsulated fluid.

Bronchoscopy as an Aid to Pulmonary Diagnosis*

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It has no doubt occurred to many that the complete chest physician should, in addition to his special competence in roentgenology, laboratory technique, physical diagnosis and surgery, become a pretty capable laryngologist. Access to the lungs, through the air passages, expulsion of mucus and pathogens by this route, point to the importance of accurate knowledge of the appearances of the nose, pharynx and larynx, as well as of the trachea and accessible bronchi, in health and in disease.

Demands upon the time of the specialist, especially in busy institutions, have, one realizes, cut down routine training along these lines. Chest physicians will, however, in the future have increasing recourse to the laryngoscopic mirror, the direct laryngoscope, and to bronchoscopic tubes for actual visualization of the reasons for sounds, wheezes, rattles, rales, dullness, and radiographic or contrast-injection shadows and obstructions.

Appearances due to upper respiratory irritations—diffuse redness of palate and fauces from smoking; lateral pharyngeal hyperplasias from sinus drainage; the glazed scarlet of pharyngeal ozoena — may explain tracheobronchitis of puzzling chronicity. It should also be remembered that definite bacteriologic proof was secured here by Prof. Larsell not long ago that sinus or tonsil drainage into cervical lymphatics reaches the vena cava and is thus pumped directly into the subpleural lung parenchyma; and also that while direct involvement of bronchi and lung by inspired material often occurs, the other pathway—lymphatic-pulmonary—is not uncommon. It is too often forgotten that low mediastinal glands become involved through ascending drainage from lung to hilus. These preliminary considerations help us to analyze peribronchial conditions in which bronchoscopy may be undertaken.

Mirror laryngoscopy should be learned thoroughly, remembering that only part of the larynx can be seen at a time. Thus one gets a preliminary notion as to the practicability of direct laryngoscopy and bronchoscopy. Normal and the commoner pathological conditions must be recognized, particularly in relation to cough and hoarseness. Causes may be purely local, or may be traced to pressures and irritation from cervical or mediastinal glands or tumors, or to central or peripheral paralyses. The appearances of early and advanced carcinoma, tuberculosis, syphilis, of polyp or papilloma, and of such rarities as leukoplakia, lepra and scleroma, must be remembered. Pressure affects the cartilages and neuromuscular structures of the larynx, sometimes at a considerable distance, in goiter, aneurysm, or mediastinal malignancy, or close by as in thyroglossal or epiglottic cyst, cervical Pott's disease, and upper oesophageal diverticulum or cancer. Such things may interfere with use of the spatula for direct laryngoscopy, or with proper position of the head and neck for introduction of the bronchoscope.

In chest cases, it is imperative that a full and complete physical and roentgenologic examination should precede any attempt at direct laryngoscopy or bronchoscopy. These are not minor procedures, and the physical condition of the patient must determine whether they may be properly undertaken. Certainly they are contraindicated in extreme cachexia or in the presence of active laryngeal ulceration.

With the thoracoscope, its usefulness depends on the skill and experience of the operator. It should be pointed out that these procedures require very complete anesthesia, always local, which must reach the carina by intratracheal injection because of the presence of nerve endings responsible for cough at the intersections of all the larger bronchi. Obviously a carefully trained team of doctors and nurses must do this work. A pick up team will not do. All manipulations, from holding the head and protecting the teeth, to the introduction of instruments,

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must be sure, rapid and gentle, and not unduly prolonged.

There are definite limitations to the size of these instruments and the extent of their field of illumination, which is readily clouded by mucus or blood. It is possible to determine by direct inspection the condition only of the trachea and right main stem bronchus; a short distance into the left main stem bronchus; and the orifices of the lower and middle lobes. To reach the upper lobe and smaller bronchi spring curved suction tips or silk dilating bougies are used.

Not presuming to discuss diseases of the lungs proper, may I point out that one looks for reasons for wheezing, cough, stridor and dyspnea, and for sources of sputum and blood. Careful examination of the mucosa will disclose pallor, congestion, inflammation, edema, infiltration, varices, ulcerative processes, atrophy, or scarring; and particularly, changes in character, consistency, amount and location of secretion or exudates.

Diffuse infiltration, which may be due to acute perichondritis preceding tuberculous ulceration, reduces the size of the lumen, and serious damage would occur if the bronchoscope were used in such a case. Any deformity or displacement of the trachea or larger bronchi, and changes in the size of lumen or in mobility during respiration or instrument use, may harbor potential dangers to bronchoscopic examination. Such disturbances in normal relations may be due to diffuse inflammation, to scars or to neoplasm or foreign body inside these cavities. Causes external to the trachea or bronchi include lymphoid enlargement (whether tuberculous, septic, neoplastic or Hodgkins'), or abscess in neck, lung or mediastinum; or aneurysm. Need for special care in fluoroscopic diagnosis and in the use of any intratracheal procedure is obvious.

Partial or complete bronchial obstruction is not always visible with the bronchoscope, though plugging of the larger openings may be seen and failure of air to come through the tube is evident. Around-the-corner dilation of such plugged areas is often possible. Consequences of such obstruction—emphysema, atelectasis, abscess—are avoided by prompt recognition of the situation. Foreign body is not infrequently an unsuspected component of such obstructions.

Ulcers are most frequently seen low in the trachea or circinate, about the mouth of a bronchus. In the latter position chronic unproductive cough is a common symptom, because of the location of nerve endings at such bifurcations. Such ulcers may continue to make sputum germ positive long after lung lesions are healed.

Granulomas and benign or malignant tumors may occur beyond bronchoscopic range either by inspection or instrumentation. In accessible regions, however, uncontaminated secretions may be secured, or biopsy specimens removed. From the latter, if malignancy is suspected, frozen sections should be secured at once so that necessary therapeutic measures may be instituted as a part of the same procedure. Introduction of radiopaque substances into specified areas of the lung can only be done through the bronchoscope.

To recapitulate, the chief indications for bronchoscopy in lung conditions are for the diagnosis and direct treatment of bronchopulmonary suppuration; of benign and malignant neoplasms; of stenosis due to edema, inflammation or ulcers, producing dyspnea, cough and eventual stricture, or damming up secretion, and of foreign bodies from irritant dusts and vegetable kernels to inhaled objects of larger size.

Facility in this sort of examination cannot be mastered by an individual working alone. Careful drill on the cadaver, on dogs, and at length as assistant on the human subject are required, and it should not be forgotten that carelessness or undue force may lead to a fatality. Team work is as important here as in any major surgical procedure.

It is, of course, unnecessary to suggest to this group that such procedures should not be indiscriminately practiced on institutional cases. Such individuals are hospitalized not for experiment, but for cure. Any other attitude is inhuman and intolerable.

It seems imperatively necessary to the development of the difficult and exacting specialty of chest diseases that all who are to make bronchoscopic examinations must have an adequate course of training, and this is strongly recommended as a prerequisite for future house officers in chest hospitals.

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Visualization of Cavities in Post-Thoracoplasty Lungs

Preliminary Report

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One of the most difficult and discouraging problems that confronts the phthisiologist and thoracic surgeon is found in that group of patients who remain sputum positive after thoracoplasty. Frequently the thoracoplasty is anatomically excellent and the underlying lung well collapsed; yet, the sputum continues to show the presence of acid fast bacilli. When bronchoscopy fails to reveal a tuberculous lesion in the trachea or major bronchi to account for the positive sputum, it must be assumed that an open parenchymal lesion is still present.

X-rays taken to locate the cavity are often barren of results. The post-thoracoplasty lung field exhibits many bizarre shadows that defy accurate description. The superimposed shadows of regenerated bone, thickened pleura, rib fragments, and areas of pulmonary and extrapulmonary fibrosis make interpretation of cavities difficult and often impossible. Unfortunately layer films have not been of any considerable assistance in locating cavities in certain post-thoracoplasty lung fields, their interpretation being as difficult as the evaluation of the six foot chest films ordinarily used. Taylor[1] notes that where no cavity is demonstrated on the ordinary film and "planigraphy is employed, the evaluation of irregular shadows becomes a difficult problem."

The surgeon is not anxious to do a revision in these cases because the indications are so vague. He would not be operating to close a visible cavity, but would perform difficult and somewhat hazardous surgery to convert a positive sputum without knowing the location of its source. In other words, we have a group of patients who have had surgery to convert a positive sputum associated with caseous pneumonic tuberculosis and who have remained positive after all indicated surgery had been performed, yet in whom it is impossible to definitely visualize a cavity as the source of the positive sputum. Therefore, the purpose of this study is an attempt to find a method that would aid in the visualization of cavities in post-thoracoplasty lungs.

Bases of the Study

First, one of the most definite criteria for the diagnosis of a cavity is the demonstration of a fluid level on the roentgenogram. It has been our experience that annular shadows, highlights, and other very convincing x-ray findings may be caused by other phenomena than cavitation. In fact this is so commonly the case that the presence of a real fluid level is the only absolute criterion for the existence of cavity in a lung collapsed by thoracoplasty. Second, we have all observed the phenomenon that many patients with chronic pulmonary tuberculosis have their maximum expectoration early in the morning, either shortly after awakening or immediately after getting out of bed. This observation holds true with patients who have had collapse therapy and in fact gains added significance as the amount of expectoration is decreased following collapse therapy. It was considered that this expectoration was largely due to bronchial secretions and in small part due to excretions from the cavity wall; that these materials accumulated during the night when the cough reflex was reduced and that if the cavity did contain retained sputum, the best time to visualize it would be just before the patient began coughing and raising. With these facts in mind, we undertook to x-ray positive post-thoracoplasty patients early in the morning before they expectorated, to see if the retained sputum could be visualized in a residual cavity as a shifting fluid level.

Material Used in Study

Only patients with persistently positive sputum were studied. All patients had at least two stages of thoracoplasty and some had revision of thoracoplasty. Patients with open

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From the Medical Service of Dr. George G. Ornstein, the Roentgenological Service of Dr. A. V. Shapiro, and the Surgical Service of Dr. Louis R. Davidson.

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contralateral pathology were not included, but patients with effective contralateral pneumothorax were utilized. Any case where the diagnosis of cavity could be definitely made on a previous recent six foot film or layer film study, was excluded. Unfortunately not every patient studied had layer films within a short time of the present study. However we feel that this is not too important since the present study is not directed at displacing any other method of diagnosis, but is primarily to add a relatively simple aid to the means of discovering cavities.

Method of Study

The patient was given codeine and phenobarbital the night before the study. The patient was definitely instructed not to expectorate in the morning. The patient was taken to the x-ray department at 5:45 A.M. and fluoroscoped at once. Six foot upright and tilt films were then taken. The patient then attempted to expectorate as much as possible and another set of films were taken. All x-rays were taken in the posterior-anterior position and the films were heavily exposed. Patients were studied on from one to six occasions. Those patients who had scant expectoration were put to bed for one or two days prior to the study.

Case Studies

A total of eighteen patients were studied sixty-two times. Fluid levels were demonstrated in seven patients or 38.8 per cent of the cases. The seven positive patients were studied twenty-three times for an approximate average of three observations per positive case.

Case 1: O. A., a thirty-three year old Negress whose symptoms began in 1936. Patient was admitted to Sea View on June 24, 1936, at which time x-ray revealed multiple excavations in the right infraclavicular region. On November 4, 1936, a single definite cavity with a fluid level was seen at the fifth to seventh right posterior ribs. Two stages of thoracoplasty were performed in November and December 1936, and the patient was discharged at Surgical Conference on March 3, 1938. However her sputum again became positive and she was re-admitted to Sea View on April 25, 1939. A revision was done in October 1939 and another in May 1940 with the total removal of nine ribs. Following the first and second stages a suspicious cavity was noted in the sixth and seventh interspaces on the right, but no cavity has been visualized since the revision. Patient raises about two ounces a day with only scant expectoration in the morning. The sputum is Gaffky 4. This patient was studied twice. The first study was indefinite, but on the second study (See Figure 1) a cavity with a fluid level was visualized at the fifth right posterior rib—the site of the cavity when last seen.

Case 2: B. P., a twenty-eight year old Negro whose symptoms began in November 1933. Pneumothorax on the left was maintained from 1933 to 1937 when it was abandoned as ineffective. Admitted to Sea View on January 27, 1939, at which time no definite cavity was seen. On February 8, 1939 x-ray revealed a bizarre annular shadow in the left mid-lung field. Sputum was positive and three stages of thoracoplasty were performed in March and June 1939 with the total removal of eight ribs. Cavity has not been visualized since the pre-operative film in February 1939. This patient raises about two ounces of sputum daily most of which is expectorated in the morning after getting out of bed. Sputum is Gaffky 4. This patient was studied five times. Four examinations were negative. However the last study on December 6th, 1940 (See Figure 2) showed a definite fluid level opposite the sixth dorsal vertebra on the left.

Case 3: J. S., a twenty-eight year old white male whose symptoms began in February 1939. He was admitted to Sea View Hospital on June 22, 1939 at which time a cavity was seen on the left extending from the fourth to the sixth left posterior ribs. Pneumothorax was not successful. A Monaldi procedure was attempted in February 1940 unsuccessfully. Three stages of thoracoplasty were performed in March, April and May 1940 with the total removal of seven ribs. On June 21, 1940 a cavity with a fluid level was seen opposite the seventh posterior rib and continued to be present until August 28, 1940, but no cavity has been visualized since that date. Patient has fluid and air in an infected decollated pocket. This patient raises about one and one-half ounces of sputum daily which is distributed through the twenty-four hour period with only scant expectoration in the morning on awakening. Sputum is Gaffky 4.

This patient was studied once, and a fluid level was seen at the sixth left posterior rib corresponding to the site of the cavity when last seen (See Figure 3). This patient could not be studied a second time because he had a revision operation shortly after our study.

Case 4: S. S., a forty-one year old white female whose symptoms began in 1938. Admitted to Sea View Hospital on August 24, 1939 at which time an infraclavicular cavity on the right was noted. Patient had two stages of thoracoplasty on the right in February 1940 and a revision in July 1940 with the total removal of seven ribs. After the first stage on February 26, 1940 the cavity was seen on the right between the fifth and sixth posterior ribs, but has not been seen on six foot PA or layer films since that date. The patient raises about six ounces of sputum daily of which four ounces are expectorated in the morning on arising. Sputum is Gaffky 4. This patient was studied five times and gave a positive result on only one occasion. On November 15, 1940 a fluid level was seen at the level of the sixth dorsal vertebra which corresponds to the site of the cavity when last visualized (See Figure 4).

Case 5: I. B., a twenty-one year old Negress whose symptoms began in 1933. She was admitted to Sea View Hospital on May 10, 1938 at which time the patient had a pneumothorax on the left, and a cavity on the right extending from the first to the fifth posterior ribs. This cavity had a fluid level. Pneumothorax on right was not successful and the patient was given a trial at bed rest with pneumothorax refills on the left being continued. Thoracoplasty on right was performed with first stage in November 1939, second stage in January 1940 and a third stage and revision in July 1940 with the total removal of seven ribs. A cavity with a fluid level was seen between fourth and fifth posterior ribs after the first stage, and opposite the fifth posterior rib after the second stage, but has not been seen in any subsequent films. This patient raises about two ounces of sputum daily with scant expectoration early in the morning. Sputum is Gaffky 3. She was studied five times; the last two times with tilt films in opposite directions. On three of these studies a shifting fluid level was noted opposite the fifth right posterior rib, which corresponds to the site of the cavity when last visualized (See Figure 5).

Case 6: M. C., a twenty-four year old Porto Rican male whose symptoms began in 1930. He was admitted to Sea View on January 13, 1938. After an ineffective pneumothorax was abandoned a cavity was visualized at the seventh posterior rib. The patient had three stages of thoracoplasty on the right in October and November 1939 and January 1940 with the total removal of seven ribs. The cavity has not been visualized since thoracoplasty but there was a suspicious anular shadow at the eighth right interspace on October 30, 1940 and layer films of February 23, 1940 showed a suspicious highlight at the ninth right posterior rib. Patient raises four ounces a day, of which two ounces are expectorated in the morning on arising. Sputum is Gaffky 4. Patient was studied three times and on one of these studies a shifting fluid level was visualized at the ninth right posterior rib—the site of the previously suspected cavity (See Figure 6).

Case 7: J. B., a forty year old white male whose symptoms began in May 1938. He was admitted to Sea View Hospital on December 27th, 1939 at which time there was an ineffective pneumothorax on the left with an open cavity extending from the second to the fifth posterior ribs. The patient had two stages of thoracoplasty in April 1940 with the removal of seven ribs. Following the first stage the cavity was seen opposite the fourth and fifth left posterior ribs, but the cavity was not seen after the second stage. The last six foot PA film on November 4, 1940 revealed an area of lessened density opposite the fourth and fifth left posterior ribs and layer films show a suspicious oval highlight in this area. This patient raises six ounces of sputum daily, half of which is expectorated early in the morning. Sputum is Gaffky 7. The patient was studied twice and on both occasions a definite shifting fluid level was visualized opposite the fifth left transverse process—the site of the previously seen cavity. An interesting feature in this case is that the cavity showed definite increase after cough (See Figure 7).

Discussion

Early in the course of the study, it was noted that large accumulations of exudate within a cavity were not to be expected. Since

the lung following thoracoplasty is largely collapsed in a medio-lateral direction, and to a lesser degree in the antero-posterior diameter, cavities which were formerly rounded or oval tend to become slit-like. In these cases one cannot expect a fluid level, when present, to be greater in width than the medio-lateral diameter of the collapsed cavity. This was noted in two cases (2 and 3).

However of greater difficulty than the alteration in the size and shape of the cavity is the paucity and variability of the retained exudate. The portion of total expectoration that is contributed by the cavitary exudate is probably quite small. Thus the amount of sputum contrast substance available at any one time to cast a fluid level shadow on the film must be small also. It follows that in certain cases faint rather than dense levels will be visualized. This was noted in three cases (4, 5 and 6). Extreme caution and patience must be observed in evaluating these shadows which may be faint but which are none the less definite. If necessary, right and left tilt films must be taken to differentiate shifting levels from shadows cast by transverse processes, posterior rib fragments or regenerated bone. In those cases where the amount of exudate is very small, it is probable that the fluid does not appear as a straight line, but rather gives a meniscus-shaped shadow at the lower pole of the cavity, or it may only be manifest by a change in contour of the lower pole of the cavity. Those cases that did show changes in the contour of the lower pole of the suspicious cavitary shadow were not included as positive cases because we were not certain of their interpretation. This presence of only small amounts of fluid constitutes a definite limitation to this method of study.

It is difficult to state just what factors are responsible for the presence or absence of retained exudate in the cavity under the circumstances utilized in this study. Apparently drainage through the broncho-cavitary junction and the amount of excretion produced by the cavity wall may vary. In any event the finding of a fluid level was not a constant observation in our cases. Eleven cases were negative at all times on thirty-nine examinations. Even in those cases where shifting fluid levels were demonstrated (seven cases) we obtained positive results in only ten studies out of a total of twenty-three.

Proof of the presence of a "check valve" mechanism was demonstrated in one case (7). In this patient the cavity increased in size after cough. Apparently the cough mechanism raised the intrabronchial pressure above that of the intracavitary pressure and forced air into the cavity. Since a check-valve mechanism was operating at the time, the air was entrapped and the cavity increased in size. The presence of this mechanism in this case probably accounts for the large amount of cavitary exudate present at the time of the study.

Sources of error in positive cases can be confined to (1) a small encapsulated pocket, and (2) bronchiectasis. The former is a remote possibility. A small previously unsuspected encapsulated hydropneumothorax pocket has never been encountered by Auerbach in a post-mortem study of thoracoplasty cases.[2] Furthermore it is unlikely that a hydropneumothorax or extrapleural decollated pocket would have a transitory shifting level without giving further evidence of its presence. The possibility of bronchiectasis is of greater importance. Auerbach[2] has found bronchiectasis in eighteen per cent of a post-mortem series of thoracoplasty cases. However in the face of a persistently positive sputum and the visualization of a shifting level at the site of the cavity when last seen, a diagnosis of vomica is much more tenable.

The use of other methods for the visualization of cavities by means of fluid levels was considered. The most obvious means was the use of large doses of expectorants such as ammonium chloride. However, this was not attempted because of the fear of increasing the chances of spread of disease by increasing the amount of expectoration and reducing its viscosity. Taylor and Bobrowitz[3] have suggested bronchial catheterization using a watery iodide solution as contrast substance. These authors visualized cavities in three out of eight thoracoplasty cases by this method. Undoubtedly this method would be of considerable value, but it presents the ever present danger, as pointed out by these authors, of a spread of disease due to the easily flowing, thin, watery solution employed. In the present study, we have attempted to use the patient's own sputum as a contrast medium.

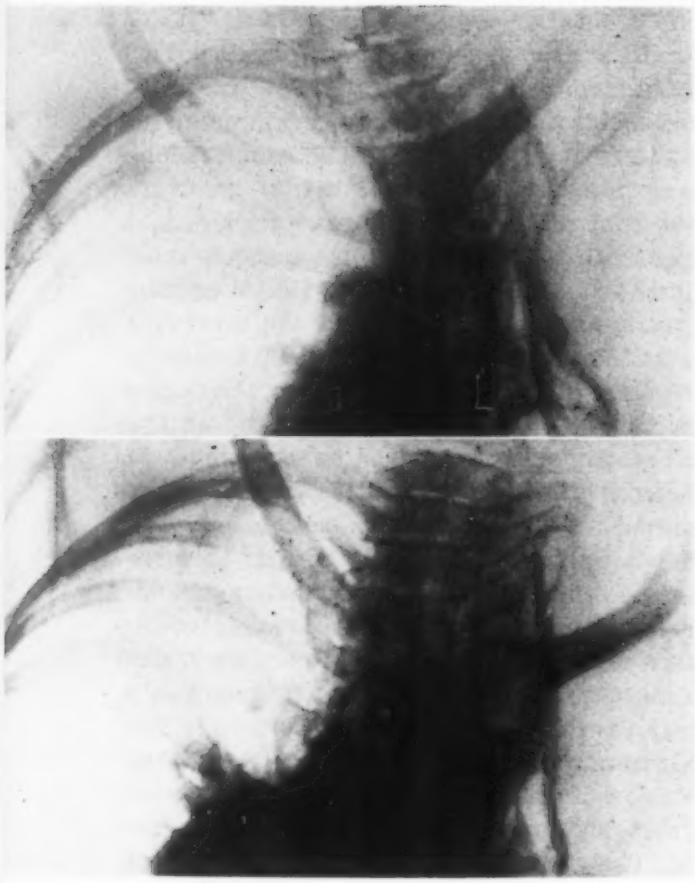

Figure 1

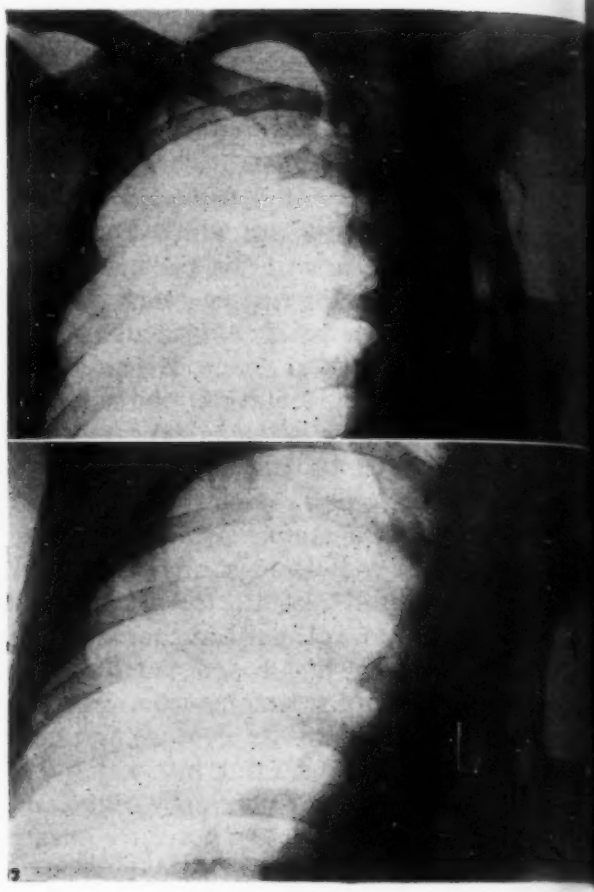

Figure 3

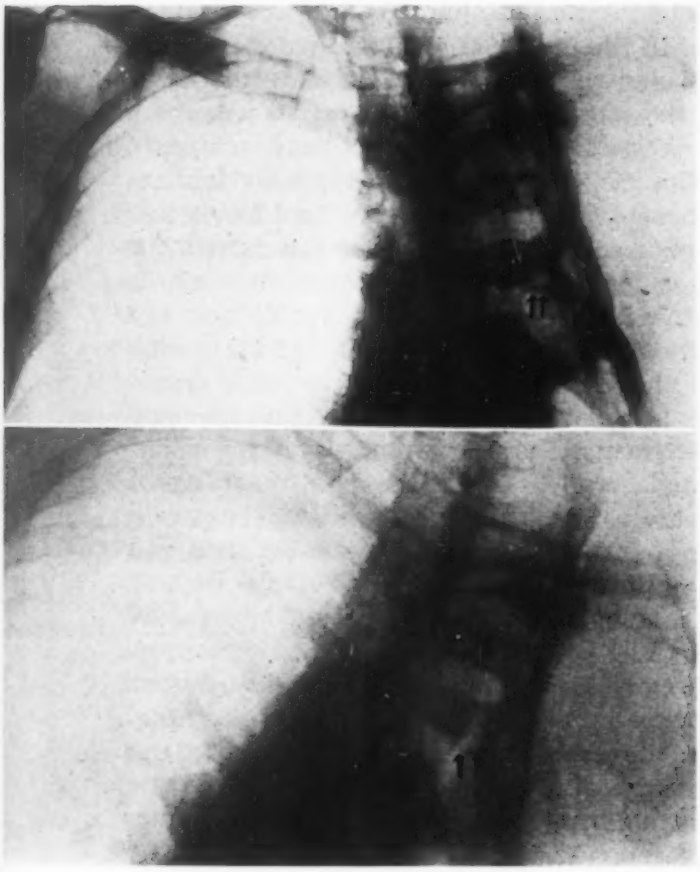

Figure 2

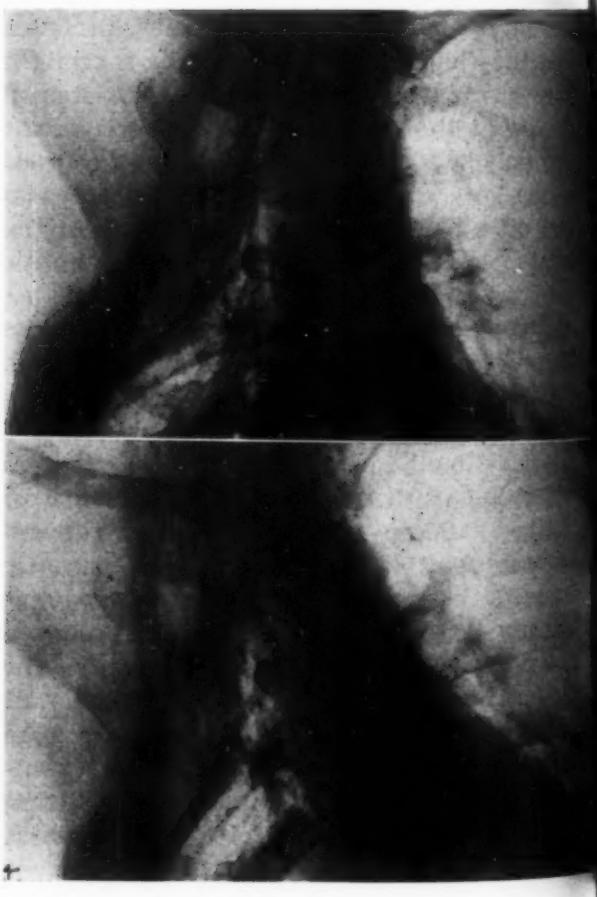

Figure 4

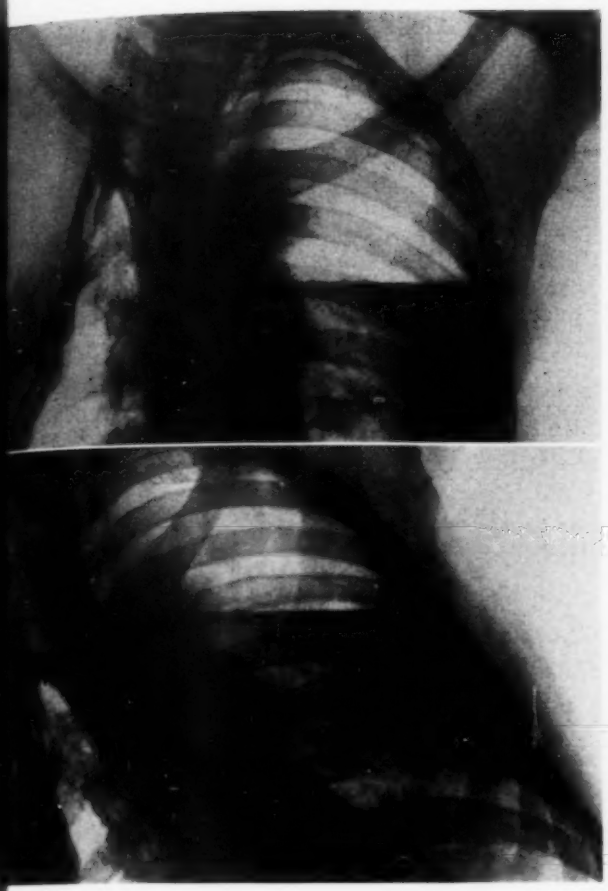

Figure 5

Figure 6

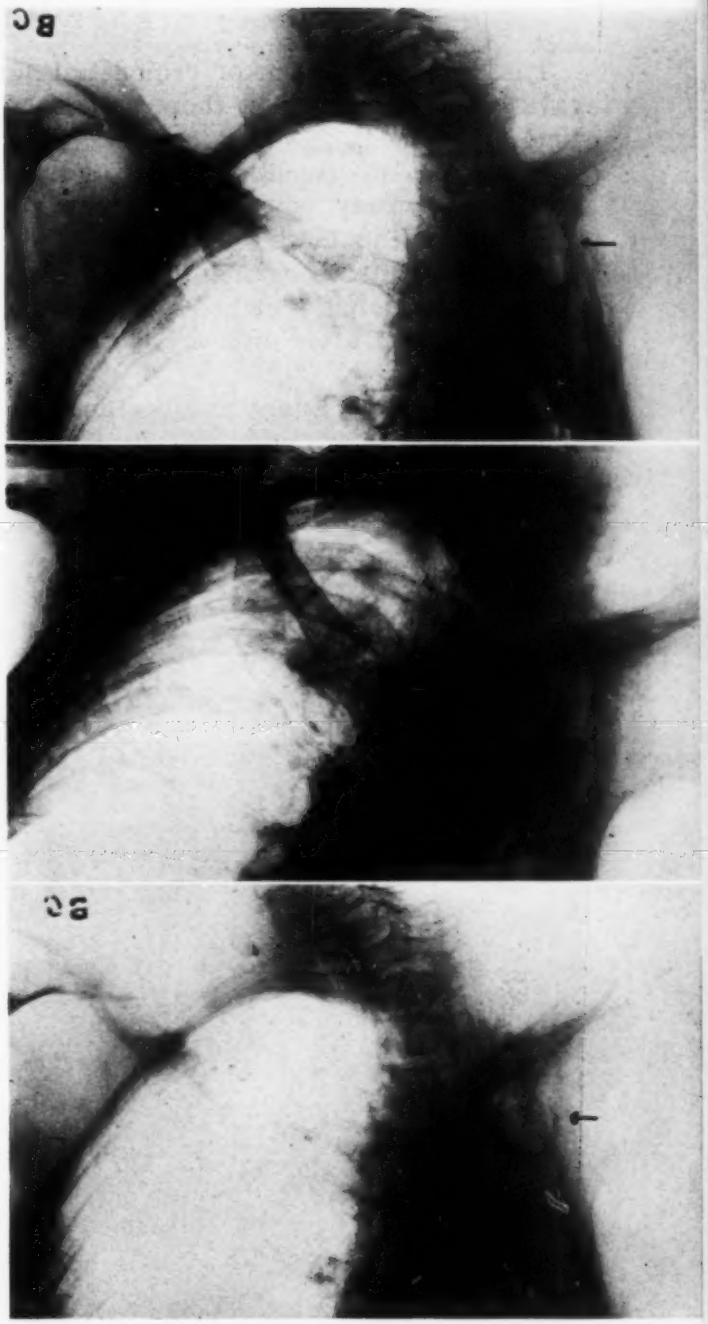

Figure 7

Fig. 1. Case 1. Fluid level below left clavicle is seen in both vertical and tilt positions.

Fig. 2. Case 2. Suspicious line indicated by arrows is shown to be fluid level when patient is tilted.

Fig. 3. Case 3. Meniscus like shadow shown by arrows maintains its horizontal position when patient is tilted. The fluid level seen to the side represents fluid in the decollated space outside of the lung.

Fig. 4. Case 4. Definite fluid level proven by tilting patient.

Fig. 5. Case 5. Secretion in cavity visualized as fluid level.

Fig. 6. Case 6. Position of cavity is proven by evidence of fluid level indicated by arrows.

Fig. 7. Case 7. Cavity shown by presence of fluid level. In C. the cavity has increased in size following cough.

Summary

The difficult problem of demonstrating a cavity in the positive post-thoracoplasty lung field is outlined.

A method of visualization of cavities in post-thoracoplasty lung fields is presented. The basis of this method is given.

Cavities with shifting fluid levels were visualized in seven out of eighteen selected cases by this method after ordinary methods had been inconclusive.

The need of persistent and cautious study is emphasized.

The limitations of the method are discussed.

The method is offered as an adjunct in the diagnosis of cavities and by no means as an exclusive measure.

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Editors Notice: This paper was read before the Seventh Annual Meeting of the American College of Chest Physicians, Cleveland, Ohio, May 31, 1941.

Coleman, Oakland

CHARLES A. DUKES, M.D.
Oakland, California

Dr. Dukes, a Fellow of the College, was elected Vice-President of the American Medical Association at the last annual meeting in Cleveland, Ohio. Dr. Dukes graduated from Cooper Medical School in 1895. He has been President of the Alameda County Medical Association and the California Medical Association; Vice-President of the American College of Surgeons; Chairman of the Cancer Committee of the American College of Surgeons; and Chairman of the Cancer Commission of the California Medical Association.

Dr. Dukes is Chief of the Surgical Service of the Alameda County Hospital; Visiting Surgeon on the Chest Service of the Veterans Administration Facility in Livermore, California; and Chief of the Gynecological Service of the Samuel Merrill Hospital.

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Organization News

PRESIDENT-ELECT GEORGIA STATE MEDICAL SOCIETY

Dr. James A. Redfearn, Albany, Georgia; a Fellow of the American College of Chest Physicians was elected as the President-Elect of the Medical Association of Georgia, at the annual meeting of the Society held at Macon, Georgia, May 13-16, 1941. Dr. Redfearn will become the ninety-fourth President of the State Medical Society and he will take over his duties as the President of the Society at its next annual meeting to be held at Augusta, Georgia, April 28 - May 1, 1942.

NEW JERSEY CHAPTER OF COLLEGE MEETS

The New Jersey Chapter of the College held a meeting at the Robert Treat Hotel, Newark, New Jersey, July 2, 1941. Minutes of the annual meeting of the Chapter held at Atlantic City on May 21st, were read and approved. A communication from the executive offices of the College with respect to the annual meeting of the College to be held at Atlantic City in 1942 was discussed and filed for consideration at the next meeting of the Chapter which is scheduled to be held in October. Dr. Marcus W. Newcomb, Browns Mills, New Jersey, Governor of the College for New Jersey presided.

Dr. Charles I. Silk, *Secretary.*

GOVERNOR OF COLLEGE PRESENTS PAPER

Dr. J. Carl Painter, Dubuque, Iowa, Governor of the College for Iowa read a paper before the Bremer County Medical Society, Waverly, Iowa, entitled: "Diagnosis of Tuberculosis."

NEWS RELEASE MEETS WITH SUCCESS

The first *News Release* mailed to the members of the College on July 10th in mimeographed form, met with an excellent response from the Fellows and Associate Members of the College. More than 100 suggestions were received on the postcard questionnaire directed to the Editor of *Diseases of the Chest*. These suggestions have been compiled at the Executive Offices of the College and they are now being studied by the Editorial Board of *Diseases of the Chest*. Many of the recommendations will no doubt be adopted by the Editorial Board of the Journal and the Editor wishes to thank those members who took the time and effort to write to him.

Many recommendations for Fellowship and for Associate Membership in the College were submitted to the Executive Secretary of the College and application forms have been mailed to all of the physicians recommended by our members. The Chairman of the Membership Committee wishes to thank those members who mailed in the recommendation slips.

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Beat three eggs, season with salt, and add all the Pablum the eggs will hold (about 2 cupfuls). Form into flat cakes and fry in bacon fat or other fat until brown. Serve with syrup, honey or jelly.

Pablum Salmon Croquettes

Mix 1 cup salmon with 1 cup Pablum and combine with 3 beaten eggs. Season, shape into cakes, and fry until brown. Serve with ketchup.

Pablum Meat Patties

Mix 1 cup Pablum and 1½ cups meat (diced or ground ham, cooked beef or chicken), add 1 cup milk or water and a beaten egg. Season, form into patties, and fry in fat.

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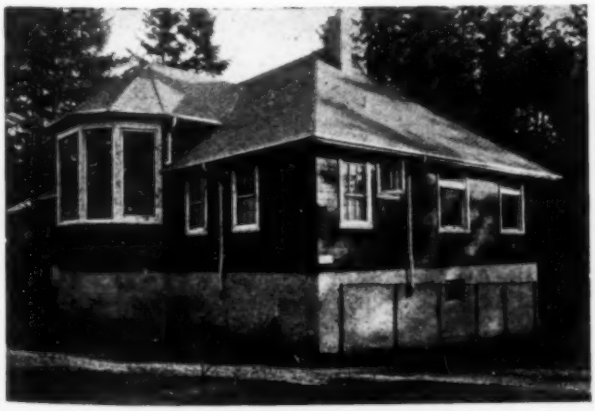

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(Continued from page 258)

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Pacific Interurban Clinical Club.

American Medical Association, Berlin.

Executive Committee (representing English speaking nations). International Artificial Pneumothorax Association.

Chairman — Early Diagnosis Committee, Oregon State Tuberculosis Association.

Vice-Chairman—Thoracic Section, Seventh Cruise Congress, Pan-American Medical Assn., Jan. 1938.

Diplomate — American Board of Internal Medicine, 1937.

Certified Internist by American Board of Internal Medicine, July 1, 1937, Cert. No. 634.

Editorial

Editor-in-Chief, "Diseases of the Chest."

Member—Editorial Staff, "Western Journal of Surg., Obstetrics and Gynecology."

Editorial Board, "The Journal of the International College of Surgeons."

Army Connections

Lt. Col.—Medical Reserve Corp, U. S. Army.

Capt.—Harvard Unit, B.E.F., 1916-17.

Hon. First Lt.—Royal Army Medical Corp.

Fraternities

Alpha Kappa Kappa—Medical.

Alpha Omega Alpha—Honorary Medical.

Chi Omega—Dental.

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Contributor, section on "Surgical Treatment of Pulmonary Tuberculosis" in *The Cyclopedia of Medicine*, F. A. Davis Co., Vol. 12, 1934. (Revision of Chapter in 1938), (revision of chapters in November, 1940).

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Mimeographed publication on "Chest Surgical Problems in the Veterans Administration" in *Report of Round Table Conference of the Veterans Administration Physicians*, June 21, 1938.

The author of numerous publications on the medical and surgical treatment of pulmonary tuberculosis.

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